drawings. However, any and all modifications will still fall within the scope of the non-limiting and exemplary embodiments.

[0043] For example, while the exemplary embodiments have been described above, it should be appreciated that the exemplary embodiments are not limited for use with only one particular type of wireless communication system, and that they may be used to advantage in other wireless communication systems such as for example E-UTRAN (UTRAN-LTE), WLAN, UTRAN, or GSM, as appropriate.

[0044] It should be noted that the terms "connected," "coupled," or any variant thereof, mean any connection or coupling, either direct or indirect, between two or more elements, and may encompass the presence of one or more intermediate elements between two elements that are "connected" or "coupled" together. The coupling or connection between the elements can be physical, logical, or a combination thereof. As employed herein two elements may be considered to be "connected" or "coupled" together by the use of one or more wires, cables and/or printed electrical connections, as well as by the use of electromagnetic energy, such as electromagnetic energy having wavelengths in the radio frequency region, the microwave region and the optical (both visible and invisible) region, as several non-limiting and non-exhaustive examples.

[0045] An exemplary embodiment provides a method for selectively performing beam formation using a RF chip-based antenna array. The method includes determining (such as by a processor for example) whether to use a plurality of antenna arrays in one or more common carrier substrates in either a single group or a plurality of groups. The method also includes, in response to determining to use the plurality of antenna arrays in a single group, providing (such as by a transmitter for example) a single coupling factor to all antenna arrays in the plurality of antenna arrays and, in response to determining to use the plurality of antenna arrays in a plurality of groups, providing (such as by a transmitter for example), for each group in the plurality of groups, a group-specific coupling factor to each antenna array in the group.

[0046] Another exemplary embodiment provides an apparatus for selectively performing beam formation using a RF chip-based antenna array. The apparatus includes at least one processor (such as DP 1224 for example) and at least one memory (such as MEM 1226 for example) storing computer program code (such as PROG 1228 for example). The at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to perform actions. The actions include determining whether to use a plurality of antenna arrays in one or more common carrier substrates in either a single group or a plurality of groups. The actions also include, in response to determining to use the plurality of antenna arrays in a single group, providing a single coupling factor to all antenna arrays in the plurality of antenna arrays and, in response to determining to use the plurality of antenna arrays in a plurality of groups, providing, for each group in the plurality of groups, a group-specific coupling factor to each antenna array in the group.

[0047] Another exemplary embodiment provides a computer readable medium for selectively performing beam formation using a RF chip-based antenna array. The computer readable medium (such as MEM 1226 for example) is tangibly encoded with a computer program (such as PROG 1228 for example) executable by a processor (such as DP 1224 for example) to perform actions. The actions include determining

whether to use a plurality of antenna arrays in one or more common carrier substrates in either a single group or a plurality of groups. The actions also include, in response to determining to use the plurality of antenna arrays in a single group, providing a single coupling factor to all antenna arrays in the plurality of antenna arrays and, in response to determining to use the plurality of antenna arrays in a plurality of groups, providing, for each group in the plurality of groups, a group-specific coupling factor to each antenna array in the group.

[0048] Another exemplary embodiment provides an apparatus for selectively performing beam formation using a RF chip-based antenna array. The apparatus includes means for determining (such as a processor for example) whether to use a plurality of antenna arrays in one or more common carrier substrates in either a single group or a plurality of groups. The apparatus also includes means for providing (such as a transmitter for example) a single coupling factor to all antenna arrays in the plurality of antenna arrays in response to determining to use the plurality of antenna arrays in a single group, and means for providing (such as a transmitter for example), for each group in the plurality of groups, a group-specific coupling factor to each antenna array in the group in response to determining to use the plurality of antenna arrays in a plurality of groups.

[0049] Furthermore, some of the features of the various non-limiting and exemplary embodiments may be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles, teachings and exemplary embodiments, and not in limitation thereof.

[0050] The following abbreviations that may be found in the specification and/or the drawing figures are defined as follows:

[0051] 3GPP third generation partnership project

[0052] ADC analog to digital converter

[0053] BW bandwidth

[0054] DAC digital to analog converter

[0055] DPD digital pre-distortion

[0056] DL downlink (eNB towards UE)

[0057] eNB E-UTRAN Node B (evolved Node 13)

[0058] E-UTRAN evolved UTRAN (LTE)

[0059] FDD frequency division duplex

[0060] GSM global system for mobile

[0061] IC integrated circuit

[0062] IF intermediate frequency

[0063] IMT-A international mobile telephony-advanced

[0064] ITU international telecommunication union

[0065] ITU-R ITU radiocommunication sector

[0066] LO local oscillator

[0067] LTE long term evolution of UTRAN (E-UTRAN)

[0068] Node B base station

[0069] RF radio frequency

[0070] RFIC radio frequency integrated circuits

[0071] TDD time division duplex

[0072] TX transmit/transmitter

[0073] UE user equipment, such as a mobile station or mobile terminal

[0074] UL uplink (UE towards eNB)

[0075] UTRAN universal terrestrial radio access network

What is claimed is:

1. A method comprising:

determining, estimating, or computing a coarse time delay represented by an integer T1;